Innovation and Development in Education

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Master of Education Policy and Development
Muhammadiyah University of Malang Indonesia

Musa Asiah Foundation Cambodia

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Preface

Strenghtening the quality of education can be realized through innovation and development of education. A model development in accordance with materials taught covers strategies, approach, and method implemented in the learning process. Various models have been developed as a trend to improve learning quality, including learning media, the integration of materials which fit to the learning condition, long-distant learning, and a web-based learning. This international seminar on education discussing innovation and development about education with concept or development implementation in education

This International Seminar on Education, a cooperation between the Postgraduate Program of the University of Muhammadiyah Malang Indonesia and Musa Asiah Foundation of Cambodia is intended to study any issues concerning with strengthening teacher professionalism thorugh an interdisciplinary approach. This seminar is appropriate and can give some chanches to share ideas useful for improving the quality of education.

Selangor, April 27 2013
Editor

Content

Problem Solving in Mathematics

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Abstract: In each problem human beings face, there must be a solution as intended. Any problem in mathematics is not so different with that in the problem condition in daily life, even the implementation of mathematics may be made use of solving any problem. Principally, there are stages to solve problems in the field of mathematics namely: a) understanding the problem; b) making a plan as a step to facilitate the implementation of the solution; c) implementaing the made plan and d) reviewing the results that have been obtained, where it is intended to avoid making any mistakes and to have a solution as intended.

Keywords: problem solving, mathematics

Each creature living in this earth must have problems, either those coming from internal or external factors. As human beings, it is neccesary for us to have a positive thinking in living this life, meaning that in any problem arising, there must be a solution.There is a good a slogan from a *State Pawning Agency* in Indonesia stating *Solving problems without problems*. The content of the slogan is undebatable, therefore, it can be used as an inspiration to always try to look for any solution for any problem arising.

In activities of learning, there must be problems to be solved, either those dealing with the presentation of the materials the teachers make or the students' mastery of the materials or even the materials themselves. Concerning with materials, in this case mathematics, various techniques and procedures of the solutions have been proposed by experts of mathematics. In mathematics, moreover, problem solvings are any activities including those in mathematics, such as the techniques and the uses of mathematics to sove problems.

Characteristics of Problem Solving in Mathematics

Each step in problem solving has different characteristics between one problem and the other. It is also the case in mathematics, problem solvings made use of possess specific characteristics which should be recognised before solving problems. Some knowledge and comprehension of characteristics of a problem may help find an intended solution. The characteristics of problem solving in mathematics are as follows:

1. In solving problems in mathematics, proper strategies are needed, either in planning or choosing the appropriate methods.
2. Strategies are important in solving any problems, while planning and choosing the methods are influenced by various factors and the most dominant factors are the knowledge and experiences since they may really influence the comprehension of the appropriate problem solvings.
3. The possessed knowledge and the levels of skills in problem solvings really influence the accuracy and appropriateness of the obtained results.
4. Each problem solving in mathematics has a different characteristic, so that any strategy employed to solve the problem should not become the memory such as the description of mathematics formulas or problem questions on the basis of memory the student has.
5. Various approahces should be learned and undersottf, so that the methods use to solve the progems may really be well implemented as intended.
6. The process of solving problems needs the implementation of systematic activities and the skills of the application of mathematics, concepts and principles that have been studied.

Types of Problems and Steps in Sollutions

Each existing problem posseses familiar characteristics and types, as an effort to facilitate the desining and the determination of the appropriate strategy, approach and method to solve the problem.

Basically, the type of problem solving in mathematics consists of two things namely routine and not routine problems.

1. Routine Problems

Each activity can be grouped into a problem commonly found in daily life and it is calle a routine problem. The next is a problem that unexpectedly comes and that might not be considered and it is unroutine problem.

Dealing with mathematics, a routine problem is a type of mathematic problem with technical form. Any effort to solve such a problems is intended to get a good basic ability, especially ability in arithmetics that involve four basic operations in mathematics, namely addition, reduction, multiplication and division. Direct application is also made by making use mathematic formulas, laws, theorems and equations.

2. Not Routine Problems

Not routine problems are various unique ones and they need aplication of skills, concepts or principles that have been learned to solve. The process of solving such problems requires systematic activities with logical planning, including appropriate strategies and accurate methods in the implementation.

After understanding types of problems to solve, the next step is to look for any solution on the basis of steps that might be able to do. According to John Dewey, problem solving can be done through five steps as shown in the following figure:

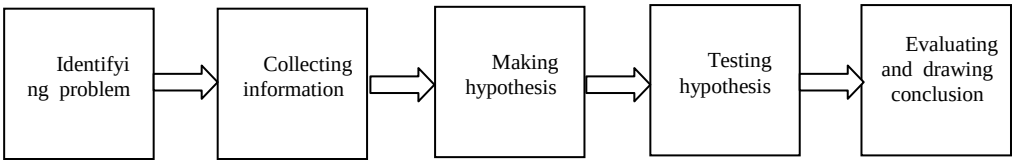

Figure 1: A Process of Problem Solving

Identifying problem is a process to really understand and to know any aspects existing in the problem. Each problem has different aspects, and it is necessary to know this as a step to determine the appropriate approach, method and strategy to solve the problem. After investigating and identifying the problem, various important and necessary information will be obtained to determine the next step in solving the problem. It is the stage in collecting the information, including the materials, and facts related to the problem.

The next step is to make a tentative answer on the basis of the obtained information, and it is combined with the knowledge and experience possessed. This stage serves as a consideration to determine the strategy and method that will be used to solve the problem. The next is to test the hypotesis that has been made in line with the strategy and the method implemented in the process of problem solving. The last is to make some evaluation and to draw conclusion dealing with the obtained results as an appropriate concluiton in solving the problem.

A Model of Problem Solving

Problems existing in solving mathematic problems make various experts propose various ideas to solve the problems stated in the model of problem solcing. There are experts who propose the model that may be used to solve problems, namely Polya and Lester.

1. Polya Model

In 1957, George Polya managed to apply a mathematic model to solve problems known as Polya Model. According to Polya, in solving mathematic problems, there are four stages that may be implemented namely: understanding the problem, planning strategies to solve the problem, implementing the solution of the problem, and reviewing the obtained result.

This model has been implemented in solving mathematic problems, either in learning mathematics at elementary school, junior high school or even senior high school, even in high education levels as a basis to solve mathematic problems.

The Polya Model leads the students to make stages and steps in solving a problem, and to complete the result of the solution made by reviewing the obtained result. This condition is actually the same with general principles used to do an activity, where in the field of organization it is called the functions of organizing, namely making plan, organizing related aspects, doing and controlling activities and results obtained. This can be made to review whether the ontained results have been relevant with the planning or not. The following is presented the four stages in detail:

a. Understanding the problem
   Understanding is an activity that should be made before making activities of problem solving. John Dewey states that to solve a problem, the first thing to do is to look for information dealing with various aspects related to the problem, where it is a step to solve any problem that will be solved. Some efforts to understand problems are as follows: a) identification of variables related to the problem; b) the relationship between the predetermined variables and c) variables which are needed through studies and answers.
b. Planning the solution of the problem
   After identifying the problem, the next step is to make a direction to plan appropriate strategies to solve the problem. Understanding the problem may produce various aspects needed to determine the plan in solving the problem. To make each activities successful as intended, it should be well planned by involving an appropriate strategy, approach and method. There are some aspects of planning that should be prepared in solving a problem: a) choosing stages appropriate with the obtained information on the problem to solve; b) making an appropriate diagram to help determine a good step to solve the problem; c) making an analogy, it is important as an effort to determine a proper strategy, approach and method by using an analogy about the problem which is relatively the same with the problem to solve and d) choosing a proper approach, since a different problems requires a different approach and not all strategies, approaches and methods can be used to solve all problems.
c. Implementing the solution of the problem
   Understanding a problem and making a good plan to solve a problem will not be meaningfull if they are not implemented yet. Some efforts intended to show that the planning is really relevant with the problem is by implementing the solution of the problem according to the chosen approach, strategy and model.
d. Reviewing the obtained result
   Forgetting and erronous are two characteristics human beings often experience. All they do is sometimes relevant and sometimes is not relevant with the implementation of the planning. An effort to solve a problem is to review the obtained answer. Such a review is done to the answer that has been obtained through an inversion method so that it will be known whether the obtained answer is really the intended answer, for instance, the problem dealing with multiplication can be known through a review using steps in division.

2. Lester Model

Lester (1978) has introduced six stages in problem solving, called *Lester* Model, namely: a) being aware of the problem; b) understanding the problem; c) analysing the objective; d) planning the strategies; e) implementing the strategies and f) evaluating the obtained results.

Lester is an expert who tried to make stages of problem solving more perfect, by adding two more aspects in the Polya Model. The added aspects are being aware of the problem andLester thniks that the step before understanding a problem starts from an awarenes of the problem to be solved. The aspect of awareness may make the understanding of the problem better. The next aspects is to analyses the objectives reached after understanding the problem to be solved before making some plans. The six aspects Lester proposes are as follows:

a. Being aware of the problem
   An awarenes is the main and the first aspect before doing an activity. Based on the awareness, any activity to do must be in line with the stages that have been designed. Then, in any activities to solve the problem, the problem solver should be aware of the forms and types of problems to solve. Such an awareness is really needed as a preliminary step in understanding the problem on faces.

b. Understanding the problem
An awareness of the types and forms of the problem may bring us to the next step namely understanding the problem. The problem solver may understand the problem well through some awarenes he/she has built. Understanding the problem is an important step before analysing the objective to reach in a problem solving.

b. Analysing the objective
Objective is the main and the first aspect in doing an activity and it will lead the implementation to get the intended result. After understanding the problem to be solved, the next step is to analyse the objective to be reached. Through the analysis of objective, appropriate strategy, approach and method can be implemented in solving the problem.

c. Planning the strategy
A strategy in solving a problem is a dominant factor in a problem solving. After the objective is determined, the next step is to determine a proper strategy to reach an intended result. A proper strategy enables the steps to solve a problem to run effectively. In planning such a strategy, some awareness and understanding of the problem and the objective to reach should be paid attention.

d. Doing the strategy
lthough the strategy chosen is the best, it will be meaningless if it is not implemented. Therefore, after the strategy is chosen, the next step is to implement the strategy which is relevant with the planned design gradually.

e. Evaluating the obtained result
The solution obtained to the problem on the basis of the arranged stages does not mean that the result is really in line with the objective and with the correctness of the solution. Therefore the next step is to reevaluate the obtained answer. This step is made to make sure that the answer is really relevant with the problem.

Difficulties in Solving Mathematic Problems

There are some difficulties in solving mathematic problems which in general are influenced by the following factors:

1. One cannot read well in order to understand the question properly so that this may reduce a proper interpretation of the mathematic language. A step to understand a question is through reading, but there are persons who cannot read such a question well. As a result, understanding of the question is vague. It is often found that a reading activity is made without full and total comprehension, so that when the activity is finished, nothing is obtained. Some efforts that should be sought are that the reading activity is accompanied by comprehension and that it is not done quickly.
2. One cannot comprehend mathematic questions well which result in mistakes in understanding concepts of mathematics.The next mistake which is often found in a problem solving is that the comprehension of a question cannot be fully achieved. And to improve the quality of comprehension of a text, rereading the problem to solve with a full understanding should be made.
3. One is doubtful about the design of solving the problem, so that there are many mathematic questions, especially geometry, that take various types of forms though principally they are the same.
4. One lacks of experiences and skills in solving mathematic problems.
5. One is doubtfull about the objective of the question, so that there are many mathematic questions that cannot be understood due to their hidden meanings or to many variations. Kesalahan menulis atau menghitung sehingga jawaban kurang akurat
6. One lacks of motivation to solve problems.

Concluding Remarks

Problems are routine conditions one always face in any learning activities. Understanding of steps in solving problems is a stage that should be paid attention and made as an effort to make the solution perfect in line with the given objective. There two steps in a problem solving proposed by two experts namely Polya and Lester, that can be used a a refence in a problem solving in line with the objective. The two experts principally have some similarities in their stages they propose namely Polays' four stages: understanding the problem, making a plan to determine the steps to determine the stepps in solving the problem, solving the problem and reviewing the obtained result.

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